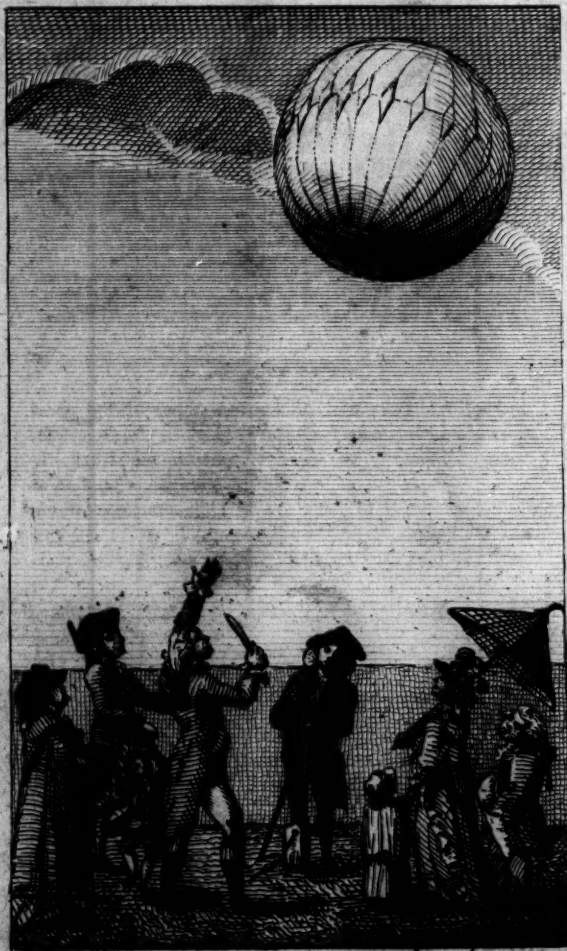


*The Air Balloon Ascending.*



*The Air Balloon Ascending.*



78

T H E  
A I R B A L L O O N :

Or a TREATISE ON  
THE AEROSTATIC GLOBE,

Lately invented by  
The celebrated Monf. MONTGOLFIER of Paris.

S H E W I N G,

First—Those Properties of  
Air, which influence an  
Air Balloon.

2dly—The particular Con-  
struction and Methods of  
filling it.

3dly—Some of the great  
Variety of probable Uses  
which this important Dis-  
covery may be applied to  
for the Benefit of Man-  
kind.

The Whole rendered familiar to the  
plainest Capacity.

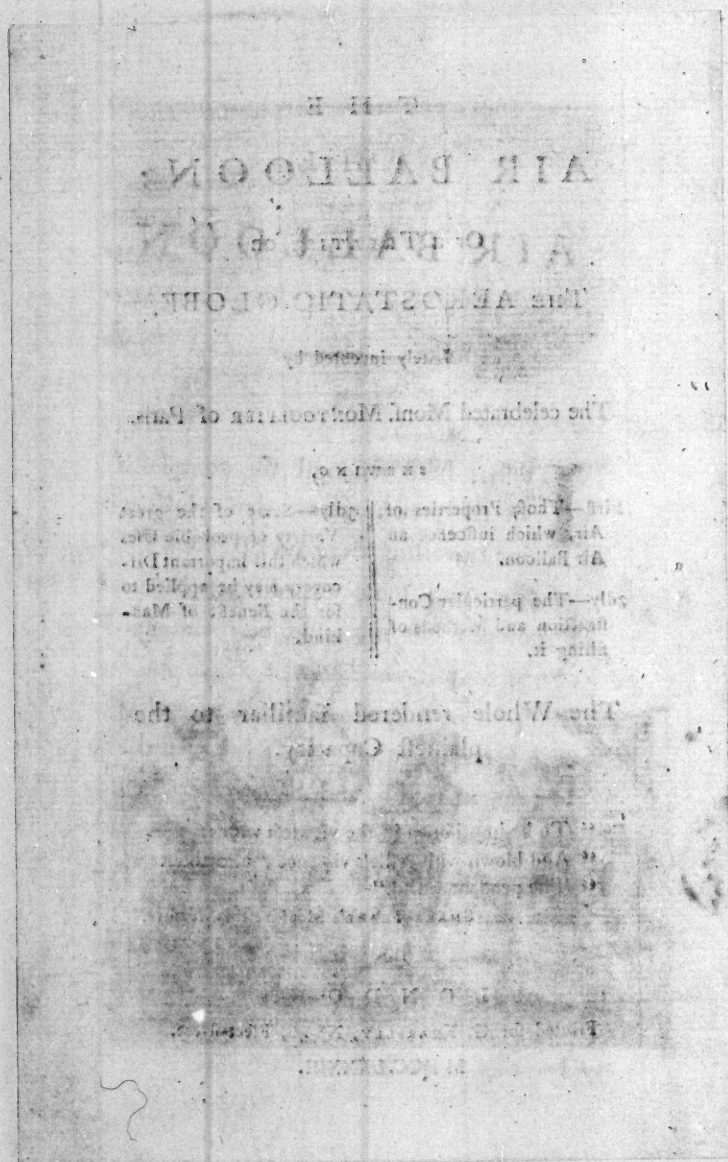
“ To be imprisoned in the virgile’s winds,  
“ And blown with restless violence round about  
“ The pendent world.”

SHAKESPEARE’S Measure for Measure.

L O N D O N :

Printed for G. KEARSLEY, N<sup>o</sup> 46, Fleet-street.

M DCC LXXXIII.





[ A ]

THE  
AIR BALLOON.

**I**T has been amongst the complaints of the present times, that whilst we are travelling the road of Moral Philosophy with some expedition, Natural Philosophy has not alike been the object of our pursuit. And indeed, if we observe the spirit of toleration, which has of late been spreading itself thro' those countries, where fanaticism and bigotry seemed to have taken up their eternal residence, and compare it with the falling off which has taken place of late years in the Philosophical Transactions of Great Britain,

this complaint will be found to have some claim. Whether this may be attributed to the superior wisdom of the present times, which is chiefly engaged about what "more immediately comes home to mens bosoms" and occasions, is not so easily determined. The present year, however, has furnished us with an experimental improvement in Natural Philosophy, which fully atones for her late repose, and which, if carried to the various uses which probability will warrant us to expect, may prove one of the most novel and serviceable discoveries that this century has produced.

What is here alluded to is *Monf. Montgolfier's* late invention of the *Aerostatic Globe*, or *Air Balloon* — an experiment, which in a very few ages back would have filled the world with amazement and wonder, and perhaps have sent the inventor to his grave with ignominy and dis-

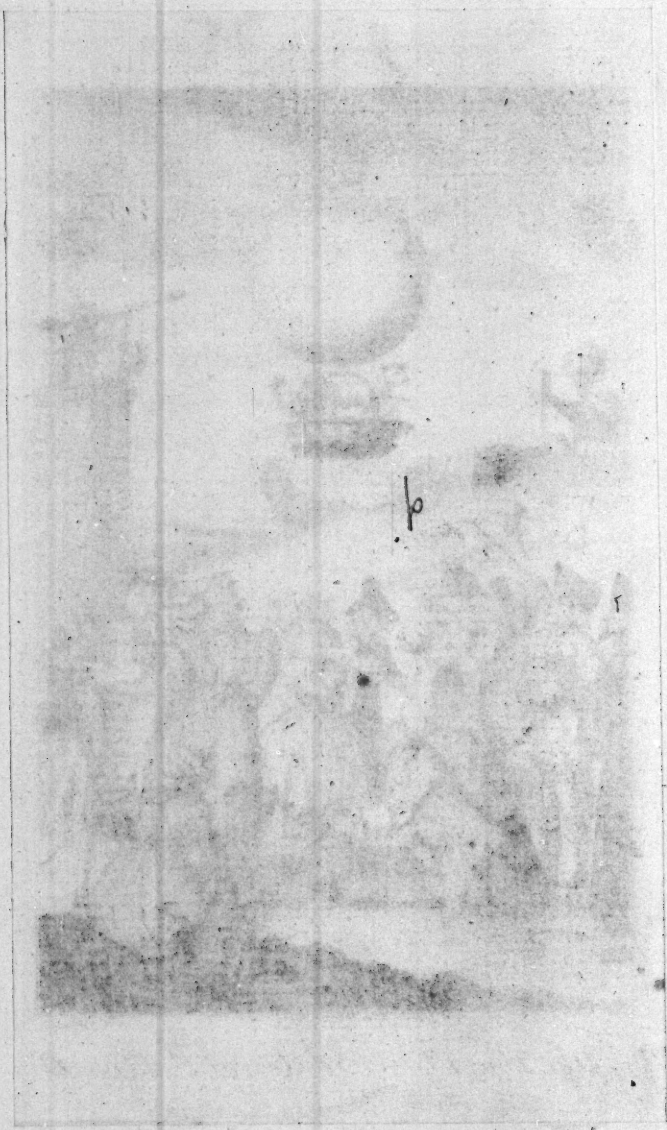


Engraved for the European Magazine. —



*The Ascent of the Aerial Balloon.*

*Published Nov. 1. 1783. by L. Fielking, Printer No. 10. Bow.*





disgrace. The times, however, in this respect, are more enlightened; for whilst this phænomenon produces novelty, and opens a wide field for speculation and improvement—it gives due honours and rewards to the Philosopher.

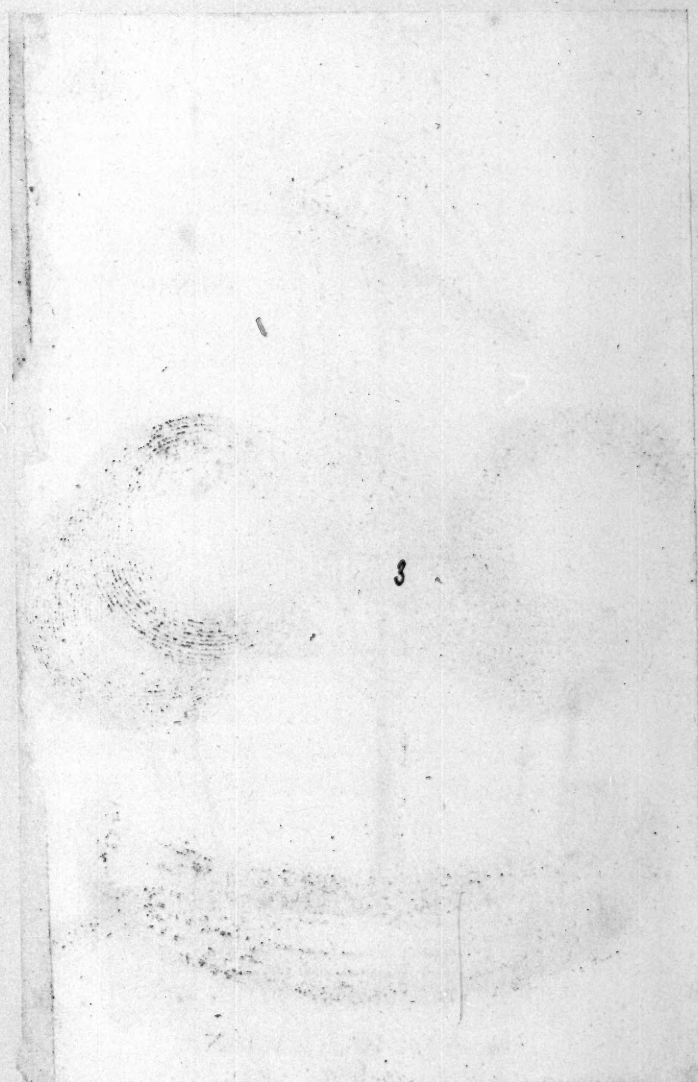
But such is the state of Natural Philosophy, that, except in a very few instances, all discoveries and experiments not only lie amongst the learned, but the publications of those discoveries are for the most part written in such a technical style, and presuppose so much scientific knowledge, that the generality of the world cannot readily comprehend them. By this I do not mean to say, that all sciences are not perhaps better explained by terms adapted to that particular science, provided the whole of the public were equally learned. But as this never can be the case—in all great and important discoveries, which may in some respect

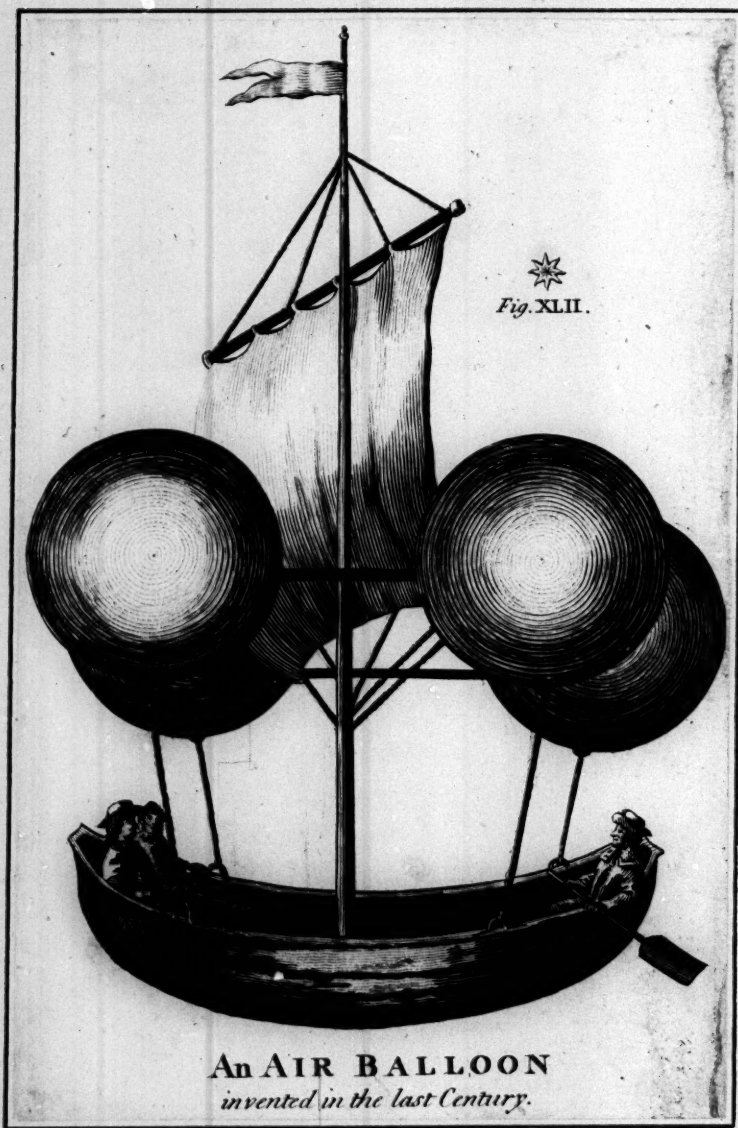
respect meet the speculation as well as the general benefit of mankind—treatises adapted to such capacities may have their use, by rousing the attention of strong, but unlettered minds, to add new discoveries out of the catalogue of more scientific researches—as it was a *paper maker* in Paris † that first sent this *Air Balloon* above our atmosphere, who knows but it might be reserved for an English miller, or wheel-wright, to add wings, or some aerial rudder to guide it through those regions with certainty and precision?

It is upon this principle I offer this little treatise to the Public, not attempting to explain any thing to the learned, who, from their particular studies and experiments in this branch of knowledge, must know much more of the subject—but to satisfy the wishes of unlettered

† Monf. Montgolfier.







**An AIR BALLOON**  
*invented in the last Century.*



curiosity, by explaining, first, those general properties of air, which influence an *Air Balloon*—second, how an *Air Balloon* is constructed, and the methods of filling it—together with some of the probable uses which such a discovery might ultimately lead to for the benefit of mankind.

*Air*, in Philosophy, signifies that thin and compressible body in which we breathe, and which surrounds the earth to a great height. The air is scarce to be perceived by ourselves, but it sufficiently discovers itself by the resistance it makes to bodies moving in it, and by its strong motion against other bodies, which is called *wind*. The laws of our existence and inevitable necessity oblige us to take in, and return this air, be it what it will; inasmuch, that all the assistances of art are vain, and all that is done for us in the common course of nature fruitless,

less, if we are deprived of its benefits. Nor is this peculiar to man or animals alone; it is the grand and necessary instrument which nature universally employs in almost all the operations she is perpetually engaged in. There is scarcely any liquid, as appears by experiments, which has not air intermixed with it, or scarcely any solid out of which it may not be extracted.

But in order to obtain a more particular knowledge of air, it will be necessary to consider distinctly some of its essential properties. The first, therefore, that offers itself to our consideration is *fluidity*. This is so natural to it, that all the various experiments which have been made, shew it cannot be deprived of it. Indeed, common observation, independent of chemical experiments, will fully prove this: for, in the sharpest frost, where every thing is congealed, the air alone remains



remains *fluid*; nay, even in an artificial cold, forty degrees greater than ever nature has been observed to produce, the air still retains its *fluidity*, notwithstanding it is acted upon by such a prodigious excess of Cold.

If you likewise compress the air with ever so great weight and force into the utmost density or compactness, yet it then does not become solid by concretion, or union of its several particles, but remains equally *fluid* as before, and as soon as ever the compression is removed, it resumes its former degree of liquidity. In the mean time it must be remembered, that the air concretes together, and unites with every species of known bodies, and serves as a kind of element in their composition. This is sufficiently evident from the large quantity of air, which, of its own accord, makes its way out of almost every body, whilst it is analyzing

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or

or reducing into its principles; and this is now usually (though perhaps not altogether properly) called factitious or made air. The fact upon examination appears to be thus: air is contained in all known liquors whatsoever, it penetrates together with them into the recesses of compound bodies; thus, at last, after a coalition of the whole, it remains locked up in the pores of those bodies, as it were, in very minute vessels, and afterwards the liquor, into which it was conveyed thither, being dissipated, it is left there alone—Hence then it is evident, that this air was not concreted there, but only lay concealed, being retained by the including body. As soon as ever therefore it can disengage itself from this confinement, it rushes out, not in the least changed, and returns with velocity to its proper nature.

The second property of air is that of *weight*, or *gravity*, which from number-  
less



less experiments (and particularly the following) is found to gravitate upon all inferior bodies.

Take a glass tube hermetically or chymically sealed, fill it with raw mercury, and invert it, immersing the open end of a tube in a basin or other vessel filled with the same fluid, so that the closed end may be perpendicular to the surface of the mercury in the basin. The tube being thus situated, the mercury will run out at the open end of the tube into the basin; till it is about twenty-eight inches above the surface of the fluid contained therein; at which height, notwithstanding the great specific gravity of the mercury, it will remain suspended in the tube. Now, it is certain, that nothing can sustain the weight of the mercury in the tube, but an external pressure on the surface of the fluid, and this can be no other than the weight of the



incumbent atmosphere, which, not being counterbalanced by the air in the tube, raises, or suspends when raised, a quantity of mercury, whose weight is equal to that of a column of air of the same diameter of the tube, in order to maintain an equilibrium.

And this appears evident from hence, that if you open the upper end of the tube, which before was closed up, the air by pressing on the mercury in the tube with the same force as it does on the mercury without it, the former will subside to the level of the latter. This is what is called "The *Torricellian* experiment," from the Italian philosopher *Torricellius* its inventor.—And on this principle depend the structure and use of the barometer.

The weight of air is continually changing in proportion to the different degrees of



of heat and cold—but the weight of the common air, near the surface of the earth, at the time of the middle weight of the atmosphere, and in the most temperate season of the year, is to that of water, as 1 to 850.

The third property of air is *elasticity*. This is that singular quality by which all known air, possessing a certain space, and being confined there so that it cannot escape, will, if it be pressed with a determined weight, reduce itself into a less space, which will be always in a reciprocal proportion to the quantity of the weight which it acts upon; with this circumstance, however, that it will constantly, by a spontaneous expansion, recover again the space it had lost, in proportion as the compressive force is diminished. This property seems peculiar to **AIR**, there being no other *elastic* fluid in nature yet discovered.

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The elasticity of the air cannot be destroyed: for, upon examination, by every kind of experiment, it has always remained the same; nor are its principles either by long rest, or the greatest pressure, ever so altered as to lose their *elasticity*. The celebrated Mr. Boyle and Mariotte having, with a particular view to this, kept common air strongly compressed and confined in a wind gun, found upon setting it at liberty, that it was perfectly as *elastic* as before; and Robervalius examining air, which had been confined in the same manner fifteen years, found that it had not lost any of its *elasticity*.

Mr. Boyle has likewise proved, that the *elastic* power, which prevails in any particular portion of the air, without any greater condensation than what is owing to the compressing air itself, can sustain all the force of a whole column of the incum-

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[ 15 ]

bent atmosphere; and also that this *elastic* power, in such a very small portion of air, can, by expanding itself, repel the bodies which compress it, with as much force as that which is exerted by the whole external body of the air.

A very small portion of air, therefore, wherever confined, is capable of producing the very same effects as a very large quantity in another place; for if any portion of common air is contained in a cavity that is easily compressible, it will then sustain the whole pressure, and entirely repel the whole body of the atmosphere. And whenever the air contained in that place is heated by fire, or freed from its external pressure, it immediately, by expanding itself, becomes so rare, as to produce effects equal to those of the greatest body of air.

Another



Another law of the *elasticity* of air is, that when it is condensed to a certain degree, it acquires by the application of heat a greater power to expand itself than it had before; and this power of rarefaction arising from heat, has the same effect, as if that air had been rendered denser, in proportion to the degree of heat which it before obtained. Unequal masses of air, but of the same density, are always equally expanded by the same degree of fire; so that these expansions in the same degree of density, by a constant law of Nature, are always in proportion to the augmentation of heat applied.—Hence, if the expansion of air of a given density by a certain degree of heat is once discovered, it will constantly hold good in all similar cases.

But with regard to the *great elasticity* of the air, this is likewise constantly observed,



served, that the more it is condensed by pressure, the greater elastic force it will acquire by the same degree of heat, and that nearly in a direct ratio of the densities. Hence it follows, that a portion of air that is exceeding dense may, by means of a very small degree of heat, acquire the greatest resisting force. Also, if you increase the density of the air, and at the same time augment the heat applied to it, the elastic power of the air will always be increased in a compound ratio of both. The last law that is discovered in the elasticity of the air is, that it is contracted into a smaller compass by cold, as it is by an increase of weight. Hence its density is always increased in proportion to the intenseness of the cold.

Having thus described the three leading properties of Air—we now come to explain

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plain how this Element is applied in the construction of an *Air Balloon*.

From the nature of air we find, that any factitious air which is lighter than the atmosphere ascends.—We see this by that air which is produced by a fire, called *smoke*, which being specifically lighter than the atmospheric air, is carried up the chimney; and only settles when it gets to that height which is equal to its own levity. This quality of air has been long understood, and various theories have been suggested to what purposes it may be applied. Though Monf. *Montgolfier*, we believe, was the first European philosopher who made it a *travelling convenience* for man, and gave to the world an experiment, which is likely to become as useful as it is at present curious.

The methods of making the air which fills this *Aerostatic Globe* is as follow;

Take



Take a certain quantity of oil of vitriol, in the proportion of an ounce to a quart of water, and mix both with filings of iron: these produce a factitious air, supposed to be about ten times lighter than the atmosphere. This air so made is by a tube conducted into the *Air Balloon* so as not to give it all the fullness of a common bladder, but rather loose in some parts, and this keeps it the longer from bursting in its progress through the air. The form of the *Air Balloon* is orbicular, or round—it is generally made of taffeta, or thin silk, on account of its lightness, and gummed on the seams, the better to prevent the air from transpiring. When it is properly filled, it is closely tied at the end, and from this moment it becomes so much a lighter body than the circumambient air, that it would immediately ascend, if not restrained by a proportionate balance. When it is let

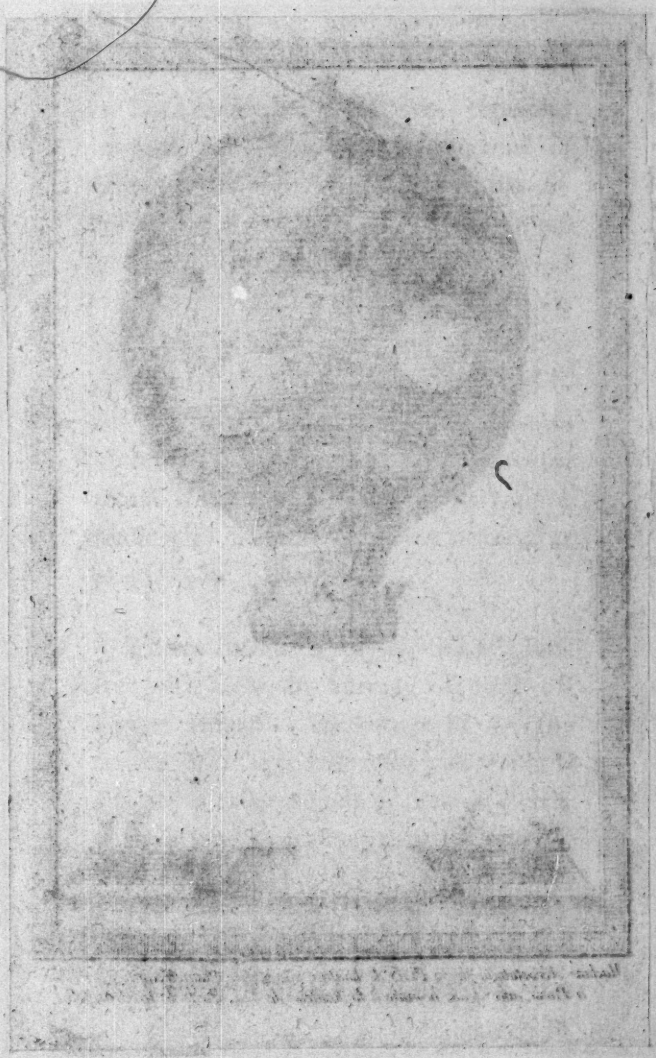


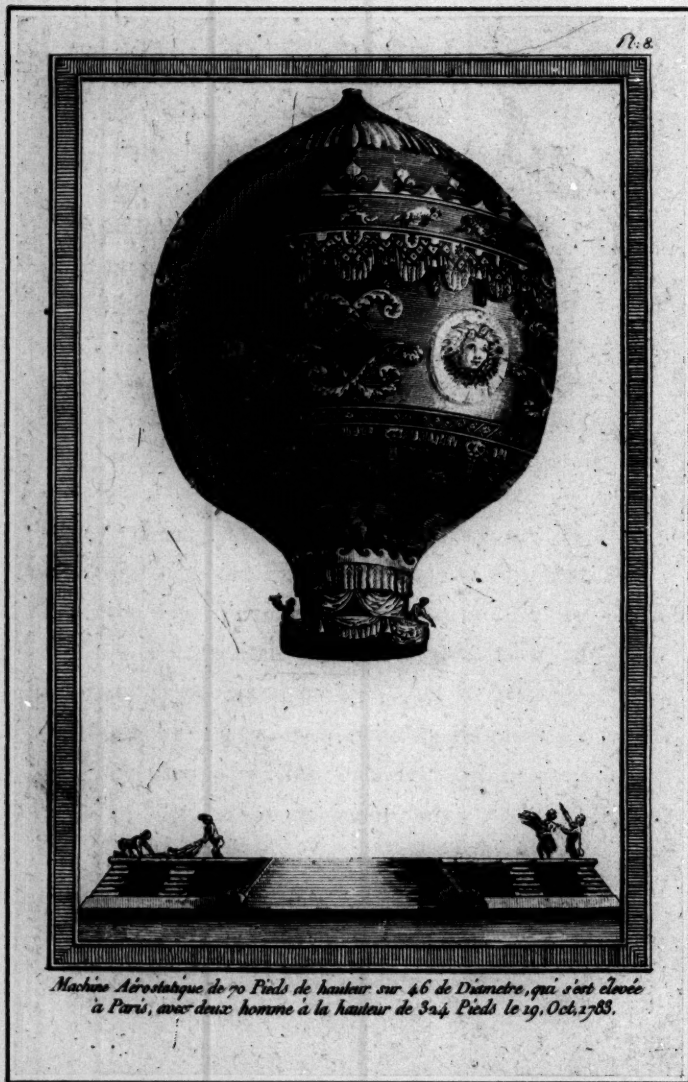
off (which is done by cutting the strings which restrain it) it rises for some time perpendicular, and rather slowly; it then follows the direction of the wind in a progressive ascent, till it reaches that region of air which is lighter than itself. This air repels it with that force, so as either to burst it, or force out by degrees the factitious air; in either case it descends with rapidity to the earth.

From this method of using an *Air Balloon*, the Public will readily see, that the experiment can only gratify curiosity—as very little or no use can be made of it, there being no possibility of restraining its height, or preventing its rapid declension—in either case it must be fatal to any person to ascend with it; as it may travel through regions of air too rarefied for human respiration, and fall with such rapidity as to crush him to pieces.

To









To remedy this, the same ingenious inventor has adopted another method of filling his *Balloon* by which he has secured its ascent and descent with more certainty and safety; which is, instead of oil of vitriol, water, and filings of iron, to make his air of that smoke which is produced by the burning of wet straw, and by carrying a quantity of this fuel with him (in a little gallery constructed round the Balloon, for the purpose of feeding it) he can ascend or descend at pleasure.

The method of supplying this last *Balloon* with air is, by burning the straw on a grate affixed to the bottom of it—the smoke of which is infused into the Balloon by a tube, to which there is a cock to let it out as occasions may require.

Of this he has made several experiments in the presence of many thousand spectators in Paris; amongst whom were  
some

some of the first rank in life and letters.

—But the greatest experiment which has as yet been made, was that on the 19th of October last by the *Sieur Giroud de Villette* and *Monf. Rozier*. The Balloon constructed for this purpose was 60 feet long and 40 broad, which being filled with air made by the smoke of wet straw was capable of taking up these two enterprizing Philosophers, together with the weight of the gallery attached to it, and several pounds weight of fuel.

They took the opportunity of a day when the wind blew across the city of Paris, and ascending at one side Port St. Jacques, crossed over to the Faubourgh St. Martin, that is, by way of making it more familiar to an English ear, (supposing the experiment was made in London) as if they ascended at St. George's Fields, and traversing across the city, came down in one of the fields near Il-lington.



The height they ascended was made by a computation, which was taken as they passed over the church of St. Sulpice, and is said to be 1650 feet, which is more than four times higher than St. Paul's. In this region (contrary to the received opinion of most philosophers, that man could not live in such rarefied air) they could breathe freely; and so supported were they by the enthusiasm of their enterprize, that they had resolution enough to enjoy the birds eye prospect of so stupendous a height, and clearly see Neuilly, St. Cloud, Seve, Iffy, Ivry, Charenton, and Choisy—Some of those place 48 miles from the capitol. The gardens about Paris appeared to them like *bouquets*, and the people passing and re-passing (according to the strong expression of Mons. Rozier) "*like so many mites in a cheese*."—No bad situation to humble the pride of man, and make him

him feel his individual littleness and insignificance in the great scale of Creation.

In respect to the weight an *Air Balloon* can carry, it must depend on the size. That constructed by Mr. Biaggini, and lately let off in the Artillery Ground, Moorfields, was ten feet diameter, and could have carried about sixteen pounds\*—so that by a computation of this kind, on a more enlarged scale, the exact weight can be readily ascertained—that lately sent up in Paris, which we have been just describing, was sixty feet long, and forty broad—and must have carried up (computing the weight of the two men, the gallery, and straw) not less than between three and four hundred weight.

\* Mr. Biaggini has just now prepared another *Air Balloon*, which he is exhibiting at the Pantheon, and which he shortly intends to let off in the Artillery Ground, 16 feet diameter, and of force sufficient to carry up a child of eight years old.

In



In respect to its rate of travelling in the air, we may very well suppose it at least fifteen miles an hour from the average calculation of experiments which have been made, without allowing for the loss of time in the perpendicular ascent, and the obstructions it is subject to meet with from the shiftings of the wind; and if in any future discovery we should be able to direct its course, there is no doubt it will travel with still more velocity.

Such is a brief and plain description of an *Air Balloon*, which has with so much justice roused the curiosity and attention of all Europe—a discovery, we must confess, hitherto merely curious, but which bids fair, from the probable improvements which may be made in it, to be highly serviceable to society.

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At present however, by this invention, we can only ascend and descend, and the latter, perhaps, not always with the most perfect security: it is besides at the mercy of the wind, "*to be blown with restless violence round about this pendent world.*" The first object of improvement therefore will be to direct its motion in the air by the means of *wings, or feathered oars.* This may appear visionary to some; but we have authority to assure the Public, that not only the original inventor of the *Air Balloon* is busied in this project, but something of a similar nature is now in great forwardness amongst ourselves, under the direction of a Scotch artist, who is already supported by a subscription of seven hundred guineas to complete it.

The machine is to be in the form of a bird: the body is to contain the inflammable air; the shaft of the wings to be nine feet long, and nine inches wide; both



both to be made of the purest elastic steel ever wrought in this country, and the whole is to be worked and directed by a person who is to go up in a basket attached to the machine.

This once obtained, the uses which might arise from it are many and various.

On the first report of a country being invaded, an *Air Balloon* would save the expences of messengers, posts, &c. from the coasts to the main army, as at the height it ascends, with the assistance of glasses, the number of the enemy, together with their place of landing, might be communicated with great dispatch.

A general likewise in the day of battle would derive singular advantage by going up in one of these machines; he would have a bird's eye view not only of every thing that was doing in his own, but the



enemy's army, and by sending down his orders occasionally (which may be done by the means of a plummet) he may literally be said

*'To ride in the whirlwind, and direct the storm.'*

Observations at Sea may likewise be made at a greater distance, and with a greater certainty than at present, which would not only be useful in time of war, and preventive of accidents at all times, but add perhaps extensive discoveries to our terrestrial globe.

During sieges they may be rendered particularly useful, by observing the works of the enemy, and of course rendering them ineffectual. Had this discovery been known even so late as the siege of Gibraltar, it would have saved that brave garrison some lives, and great labour, as occasional turrets were obliged to be built the better to observe the operations

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tions of the enemy—all which an *Air Balloon* would have saved. In cases of fires in capitals or large towns, an *Air Balloon* let off would instantly ascertain where the fire was, and of course occasion a more direct and speedy assistance.

To maintain a war of posts, as was pretty much the case in the late war in America, an *Air Balloon* would be of the most singular advantage. For instance, had the troops in that unfortunate expedition to Albany been provided with this celebrated discovery, to give necessary signals and intelligence to the detachment who were to support them; the effects of that unfortunate day would not be recorded, as they now are, in the debilitated and humiliating state of Great Britain.

In Natural Philosophy it bids fair to make many great and considerable improvements.



provements. It is well known, that our great philosopher Dr. Franklyn, by means of an artificial Kite, has already drawn down lightning from the clouds: Why may not this experiment be improved by means of an *Air Balloon*? When the appearance and approach of clouds prognosticate immediate thunder, an *Air Balloon* carrying up conductors might draw it down, and separate that force, which oft has proved fatal to the lives of many. In the West and East Indies, where thunder storms are infinitely more frequent and mischievous than in these countries, it would be a discovery of the most salutary kind, and as its objects would be of such material advantage to the natives, there is little doubt but such further improvements may be made, as the very bad effects of thunder may in a great measure be prevented.

Physics may keep equal pace with the other improvements in Natural Philosophy:

for



## [ 31 ]

for as the great organs of our senses, tast-  
ing, feeling, hearing, and smelling, are  
communicated to us thro' the medium of  
the air, who can say what improvements  
the constitution might receive from such  
quick and elevated changes? We all  
know, that some invalids are only kept  
alive by what physicians call the *change of*  
*air*, that is, by travelling from one coun-  
try or town to another—but as the air is  
always allowed to be purer in its *ascent*,  
and as an *Air Balloon* can regulate that  
ascent to precision, the benefits may be  
of the most valuable kind. In *asthmas*  
and *decays* it may turn out a specific,  
and in other diseases, though not so pow-  
erful, yet highly serviceable.

In short, as the various properties of  
air are at present so well known to con-  
tribute to the preservation of our exist-  
ence, what are we not led to hope from  
a knowledge of using it, and living in

[ 32 ]

it in a purer and more extensive degree  
 than ever! The present period seems to  
 be a favourable omen for the extension  
 and encouragement of this discovery—  
 as PEACE, the parent and patron of all  
 knowledge, has happily once more re-  
 visited Europe, and calls upon its philo-  
 sophers and artists to erase the ravages of  
 war, by the cultivation of useful and  
 ornamental science.





97

## POSTSCRIPT.

SINCE writing the above, the Editor is favoured with a letter from a respectable correspondent in Paris, dated the 3d of December, acquainting him of a late experiment made of the *Air Balloon*, which he is happy in laying before the public, as it in a great measure justifies the sanguine hopes he entertains of its further improvement.

“ On Monday the 1st of December an *Air Balloon*, under the direction of Messrs. Charles and Roberts, was let off from the Thuilleries. It had suspended to it a basket, covered with blue silk and paper finely gilt, in the shape of a triumphal car, in which Mr. Charles and Mr. Roberts embarked, and mounted up into the air, amidst many thousands of people of all ranks and conditions, perhaps three or four hundred thousand. Beside the Duke de Chartres and a great part of the French nobility, there were the Duke

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and Dukes of Cumberland, the Duke and Dukes of Manchester, and many other foreign princes and nobility. The philosophers had flags with them of different colours, with which, as they mounted aloft, they saluted the admiring world below. When they came to the height at which they meant to sail (which was computed to be about twice the height of St. Paul's) they threw down a flag as agreed. They then glided along a steady horizontal track over the Fauxbourg, St. Honore, saluting the people as they went along, with their flags; and landed at about 20 miles distance from the place they set out from, being accompanied (*sur la terre*) by the Duke de Chartres, and several of the French and English nobility and gentry, who came in almost at their landing. Mr. Roberts then got out, when Mr. Charles, after throwing out some ballast to lighten the machine, ascended alone in the *Balloon* to the almost incredible height of



## [ 35 ]

15026 toises, or 3052 yards perpendicular, in about ten minutes.

“ The account Mr. Charles gives of his observations during this time (which is published in the Journal of to-day) is, that he lost sight of every thing below upon earth, and saw nothing but a wide expanse of fine æther—that the Barometer fell from 28 to 18, and the Thermometer from 7 above freezing to 5 below it. He descended about four or five miles from the spot he got up, near the house of a Mr. Farrar, an English gentleman, where he slept that night, and was brought to town by a nobleman in his own carriage the next day, amidst the general acclamations of the Public.

“ The Balloon was composed of red and straw-coloured taffeta, which were pieced alternately, so as to appear like meridional lines upon a terrestrial globe. The upper hemisphere was covered with a netting, surrounded at the bottom by a hoop,

a hoop, to which the car was suspended; so that the elastic pressure of the inflammable air was equally repressed by all the meshes of the net above. Mons. Montgolfier attended during the whole of the experiment."

We are sorry to add to this account, that on the arrival of Mess. Charles and Roberts in Paris, they were arrested by order of the King, who, as *father of his people*, was advised by some bigotted Ecclesiastics to prevent the farther endangering the lives of his subjects.—But as great interest is making for them by the princes of the blood, together with all the philosophers in Paris, it is thought they will speedily be discharged. Public curiosity is much damped by this circumstance, as the next experiment Mr. Charles meant to make of the *Air Balloon* was to take a trip in it from Calais to Dover, in which he was to be accompanied by the celebrated Mons. *Bougainville*.

T H E E N D.